CSC-257
Theory Of Computation
(BSc CSIT, TU)

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Derivation Tree / Parse Tree

- Parse tree is a tree representation of strings of terminals using the productions defined by the grammar.
- It is pictorial representation of derivation of a string defined by a grammar.
- A parse tree pictorially shows how the start symbol of a grammar derives a string in the language
- Parse tree may be viewed as a graphical representation for a derivation that filters out the choice regarding the replacement order

Derivation Tree / Parse Tree

- Formally, given a Context Free Grammar G = (V, T, P, S), a parse tree is a tree having following properties :
  - The root is labeled by the start symbol
  - Each interior node of parse tree are variables(Non Terminals)
  - Each leaf node of parse is labeled by a terminal symbol or ε
  - If an interior node is labeled with a non terminal A and its childrens are $x_1, x_2 \ldots\ldots\ldots\ldots x_n$ from left to right then there is a production P as : $A \rightarrow x_1, x_2, \ldots\ldots\ldots\ldots\ldots x_n$ for each $x_i \in T$

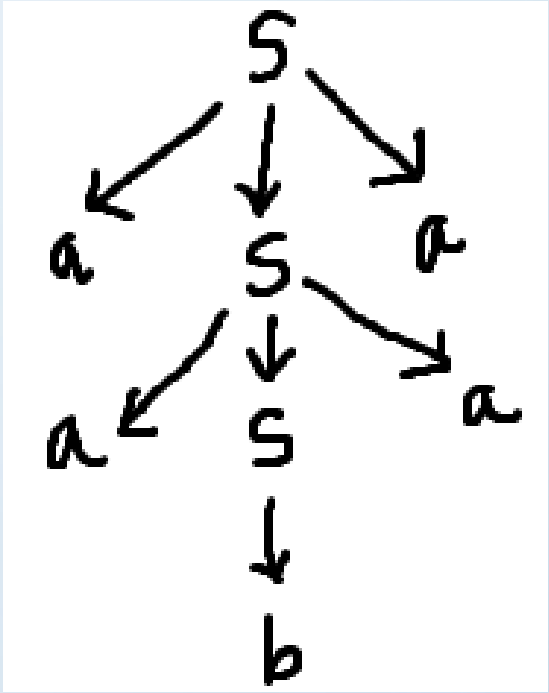
Derivation Tree / Parse Tree

- Consider a grammar S → aSa | a | b | ε
- Now for string S →* aabaa, we have

  S → aSa

  S → aaSaa

  S → aabaa
- And the parse tree is :



Derivation Tree / Parse Tree

- **Exercise : 1**
- Consider the Grammar G :

  S → A1B

  A → 0A | ε

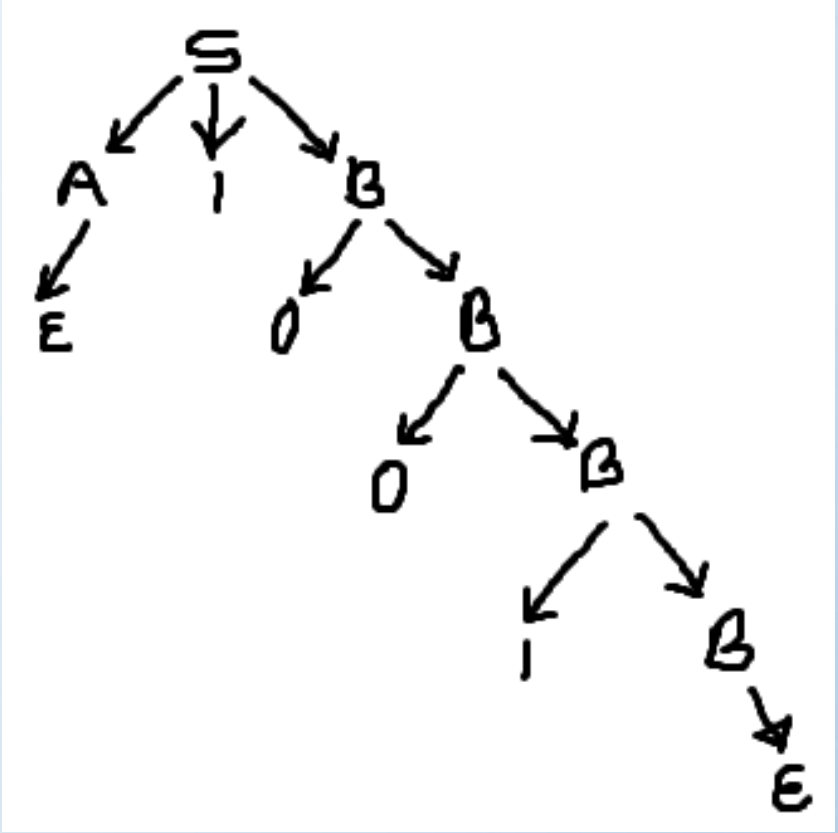
  B → 0B | 1B | ε

a) Construct the parse tree for 00101

b) Construct the parse tree for 1001

c) Construct the parse tree for 00011

Note : Construct parse trees for both leftmost as well as for rightmost derivation



Parse tree for 1001 : leftmost derivation

Derivation Tree / Parse Tree

- **Exercise : 2**
- Consider a CFG G :

  S → S + S

  S → S * S

  S → S

  S → a
- And the string to be derived is "a+a*a”
- Construct the parse trees for leftmost and rightmost derivation of string and derivations are given as

S → S + S
S → a + S
S → a + S * S
S → a + a * S
S → a + a * a

leftmost derivation

S → S * S
S → S * a
S → S + S * a
S → S + a * a
S → a + a * a

rightmost derivation