Compiler Construction

Trees

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  $A \to AAA \mid bA \mid Ab \mid a$
- The word ”baab” can be generated by the above CFG as,

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- $S \rightarrow AA \rightarrow bAA \rightarrow bAAb \rightarrow baab$

Syntactic Tree continued ...

- $S \rightarrow AA$
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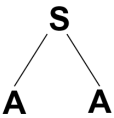
- $S \rightarrow AA \rightarrow BAA \rightarrow BAAB \rightarrow baab$
- Drawing the downward lines from S to each character of this string as follows,



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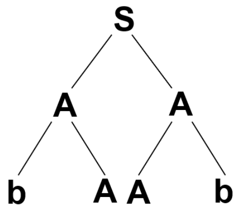

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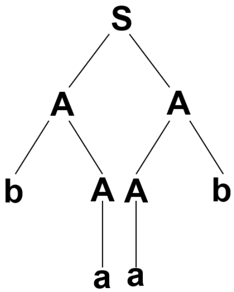

Total Language Tree

- For a given CFG, a tree with the start Symbol S as its root
- whose nodes are working strings of terminals and non-terminals
- The descendants of each node are all possible results of applying every production to the working string
- This tree is called **total language tree**

Total Language Tree example 1

- Consider the following CFG,

  $S \rightarrow aa \mid bX \mid aXX$
  $X \rightarrow ab \mid b$

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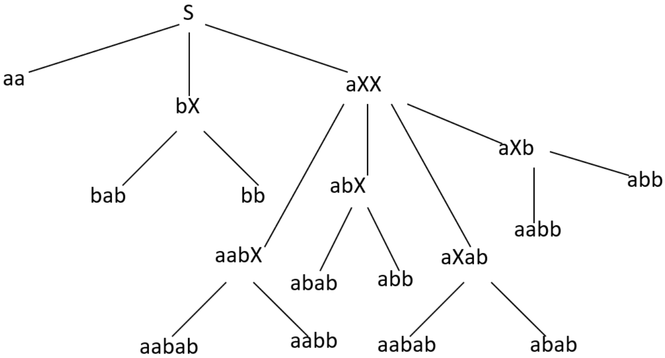

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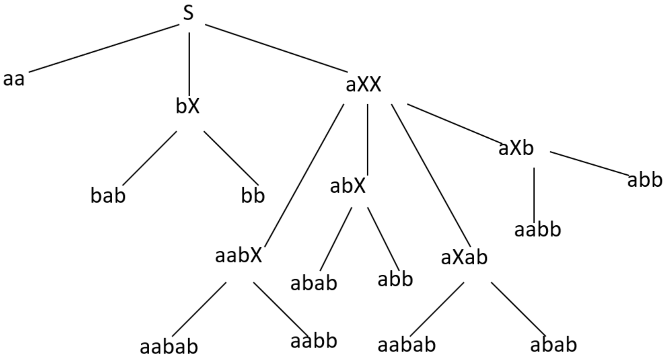

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  X $\rightarrow$ ab | b
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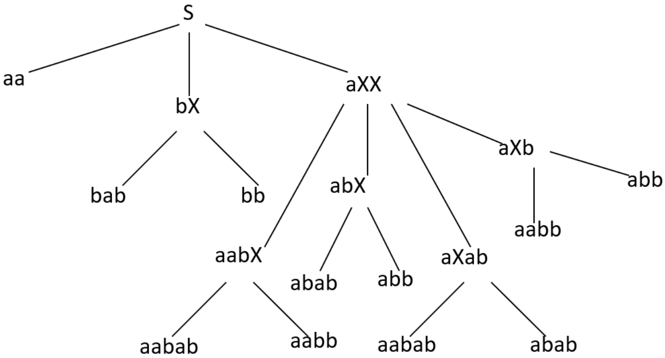
- {aa, bab, bb, aabab, aabb, abab, abb}



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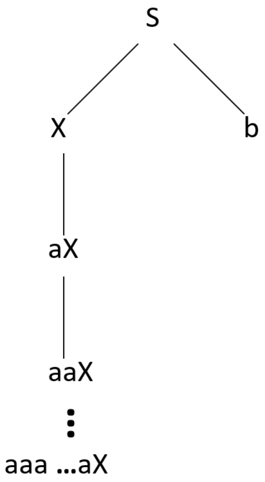

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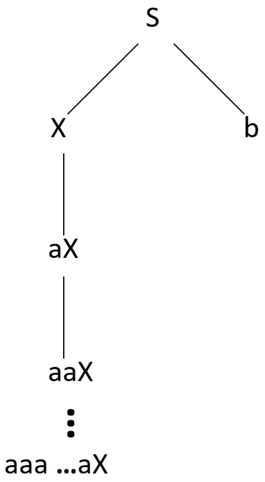
- It is to be noted that the only word generated by this language is, $\{b\}$



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- Finite Automaton (FA) can be converted into corresponding CFG

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  - Each state ’i’ of the FA creates a non-terminal symbol ’A’
  - If a state ’i’ has a transaction to the state ’j’ on a symbol ’a’, i.e., δ(i,a) = j, then introduce a production rule of the following,
    $A_i \rightarrow aA_j$

FA to CFG conversion

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- If state 'i' is an accepting state, then introduce a production rule of the form $A_i \rightarrow \epsilon$
- If state 'i' is the start state, then A_i is the start symbol (non-terminal) of the grammar.

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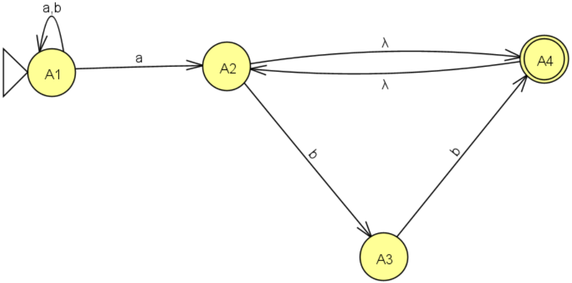

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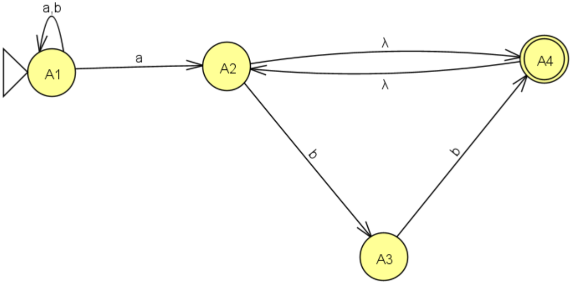

$$A_1 \rightarrow aA_1$$
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$$A_1 \rightarrow aA_2$$
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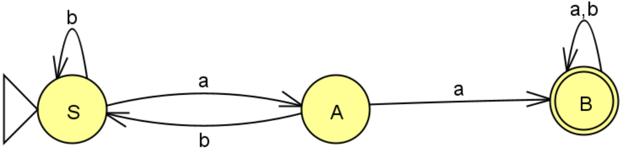

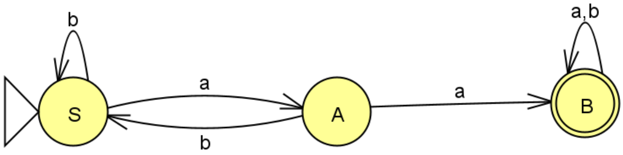

- The corresponding CFG may be,

$$S \rightarrow bS \mid aA$$

$$A \rightarrow aB \mid bS$$

$$B \rightarrow aB \mid bB \mid \epsilon$$

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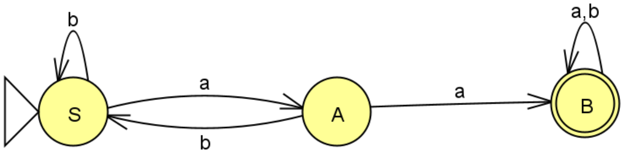

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- It may be noted that the number of terminals in the above CFG is equal to the number of states of corresponding FA
- where S corresponds to the initial state
- each transition defines a production

RE to CFG: Example 3

- Construct FA and grammar for the following RE,

$$(a|b)^* bbb(a|b)^*$$