

Define parse tree. What are the conditions for constructing a parse tree from a CFG ?

A parse tree is like a family tree for a sentence in a programming language or any other context-free language. It shows how the sentence can be broken down into smaller parts according to the rules of a grammar.

Here's a simpler breakdown of the conditions for constructing a parse tree from a context-free grammar (CFG):

1. Every part of the tree needs a label: Just like every person in a family tree has a name, every part of a parse tree needs to be labeled. The label can be either a word (like "noun" or "verb") or a symbol from the grammar (like "S" for the start symbol).
2. The start symbol goes at the top: Just as a family tree usually starts with the oldest generation at the top, a parse tree starts with the start symbol of the grammar at the top.
3. Inside parts of the tree are non-terminals: If you look inside a family tree, you see people's names, not just "mom" or "dad". Similarly, the inside parts of a parse tree are labeled with non-terminal symbols, which represent groups of words or phrases according to the grammar.
4. Each production rule forms a branch: Think of a production rule in the grammar as a recipe for making a certain part of a sentence. When constructing the parse tree, each production rule corresponds to a branch where the parent node is labeled with the non-terminal symbol being replaced, and the children nodes are labeled with the symbols or words that it's replaced with.
5. Terminals or null symbols are at the ends: Just like leaves on a family tree are the individual people, the leaves of a parse tree are the individual words or symbols from the input sentence, or sometimes they can be empty (represented by  $\epsilon$ ), depending on the grammar.

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