The purpose of compliers in computing is essential, it gives users the power to write and execute the code that they have written. The use of Context-free grammars (CFGs) is to define the syntax of programming languages and ensure that the coders can express ideas effectively while adhering to the language rules, ensuring syntactically correct code. (Patil, et al., 2023).

Context-free grammar is a 4-tuple, meaning it is made up of only 4 grammar rules. V, which is a finite set of pre-determined variables, these are then what goes on to be able to create different derivations of the grammar. Sigma Σ is the finite set of terminals, these are parts that cannot be changed, and these will end the branch of code. R is the production rules that are also finite, the production rules are represented as A → w. A is the variable that is being changed and w is the string of either variables, terminals, or both, that will be replacing the initial variable. Finally, S is the start symbol, representing the start of the derivation or the parse tree. (Sipser, 2018)

The correct way to state a class of languages is with a CFG, CFG parsing is made up from two different phases, one phase is the lexical analysis. This phase consists of data being scanned and then the series of expressions are defined and separated by delimiters. The second phase is syntactic analysis, this is where the string symbols are indeed conforming to the rules that are in the grammar. (Hamza, 2017)

Without Syntax Validation, compiling code would be a problem, this issue is solved using CFGs. This means that a complex program that would have its syntax checked and verified to ensure that the code follows the rules of its required syntax. A syntax also known as parsing, is the process of the compiler taking the components of the code and forming them in a tree-like structure (Aho, et al., 2013). Meaning that there is a specific order that should be followed when writing and compiling code to ensure maximum compatibility.

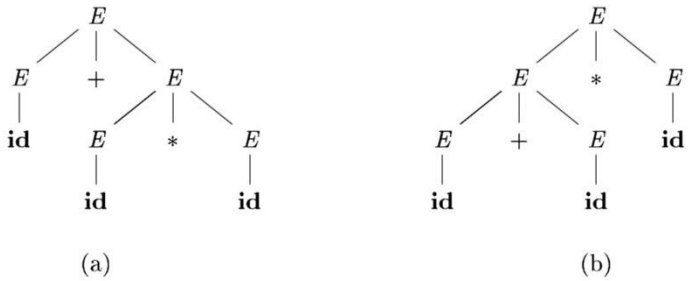

Figure 1: Two Parse Trees for **id+id*id**

(Aho, et al., 2013, pp. 204, Figure 4.5)

CFG's Can also be aligned into a syntax tree, this can better be used to understand how the flow works going from the variables to either other variables or the terminal. As shown in Figure 1, CFG's are represented with the starting symbol at the top with the following variables or terminals below, along with any expressions shown between the variables.

Without CFG there would be no mechanism to validate syntax, this would mean that bugs and errors would be far more prevalent in programs with no real way of finding the mistakes that cause the program to error and removing them. This would make programming and software development time-consuming and tedious as there are no rules that should be followed that would usually be validated with the CFGs.

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