

Programming Languages: Syntax

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2025-09-17

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Announcements and Reminders

- Sound and visuals check.
- Main online resource: Class Web site:
 - <http://chaw.eip10.org/cos301/>
 - also linked from my Web page, etc.
 - Includes (is) **syllabus**.
- Brightspace for **some things only**.
 - **discussion forum**.
 - homework and other **submissions**.
- **Homework HW01** due soon, not trivial.
- Rules for use of **Gen AI**.

Plan for today

- Material from Chapter 2 of the textbook.
 - (Continuing) Theory of CFGs etc.
 - Derivations (2.4).
 - *Parse trees* (2.5) and *abstract syntax trees (AST)* (2.6).
- (Review) Bigger picture question (related to homework):
 - How to implement a simple language like:
 - $x = 5 + 3$
 - $y = 48 / (4 * 4)$
 - $z = x + 2 * y$
 - etc.

(Review) CFG formally

- Theoretical underpinning of (E)BNF and much much more.
- $G = (N, T, P, S)$
 - N : a set of symbols (*nonterminals*)
 - T : another set of symbols (*terminals*)
 - $N \cap T = \emptyset$
 - P : set of *productions*
 - each of form $n \rightarrow \alpha$ where
 - where $n \in N$ and $\alpha \in \{N \cup T\}^*$
 - $S \in N$: special nonterminal called *start*

(Review) CFG for infix expressions

- example from the textbook

- Main question: Can a given string of tokens (terminals) be generated by a given grammar?
 - If so, how? Show the steps starting with the start symbol.
 - Is the derivation unique?
 - Is the leftmost derivation unique?
- Switch to example and practice in textbook.

- Informally, a tree that has S as root and the children of each node are the items on the RHS of the rule that was used to replace the corresponding nonterminal. (Leaves correspond to terminals.)
- Example for infix expressions.
- Switch to practice problems.

Abstract Syntax Trees

- closely related to, but different from, parse trees.
- abstract away unimportant details such as order in which a sequence of nonterminals is expanded.
- Two main changes:
 - Nonterminal nodes are replaced by *corresponding* parts of the input sentence.
 - Unit productions are collapsed.
- Example for infix expressions.
- Practice problems in textbook.

Summary

- (E)BNF, CFGs, derivations, parse trees, ASTs.
- CFG formal definition.
- Practical examples of CFGs.
- Bigger picture:
 - Process source code into AST
 - then we can interpret or compile it etc.
- Class Web site: <http://chaw.eip10.org/cos301/>